Assessment of the Accuracy of the UCLA-LBLE Radiative Transfer Model for Inferring VIIRS Cloud Environmental Data Records

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Abstract

To support the verification and implementation of the Visible/Infrared Imaging/Radiometric Suites (VIIRS) algorithms used for inferring cloud environmental data records (EDRs), and to assess the accuracy of the simulated cloudy radiances/reflectances from the UCLA line-by-line equivalent (LBLE) radiative transfer model (RTM), two important studies are carried out. First, for the purpose of evaluating the feasibility of using the Moderate-Resolution Transmission Model Version 4 (MODTRAN-4) to generate simulated cloudy radiances/reflectances in synthetic tests, we compare visible and near-infrared reflectances and infrared radiances from the UCLA-LBLE RTM with those from MODTRAN4 run with the 16-stream discrete-ordinate scattering model DISORT. We find differences in visible and near-infrared reflectances for typical ice and water cloud optical depths and particle sizes. These discrepancies are possibly due to different physics (non-spherical ice crystal vs. Henyey-Greenstein) and mathematics (200-term Legendre polynomial expansion in the adding-doubling procedure vs. 16-stream Gaussian quadrature in DISORT) in phase functions used in each model. We also find substantial differences in the infrared radiances for optically thick clouds. These differences, caused by inadequate thick cloud calculation procedures in the current release of MODTRAN4, are drastically reduced to a few percent after relevant sections of MODTRAN4 were corrected*. The comparison not only impacts the prospective test plan for the VIIRS cloud algorithms, but also leads to improvements in future MODTRAN releases. Second, to interpret results of VIIRS solar retrieval algorithm using MODIS proxy data, and to evaluate the validity of VIIRS look-up tables (LUTs), we compare VIIRS and MODIS simulated visible and near-infrared reflectances for various sun-satellite geometries, optical depths and particle sizes. Differences between the two LUTs are discussed in terms of the different phase functions and radiative transfer models that have been used to produce reflectances in each LUT.

* The authors wish to acknowledge the timely efforts of the MODTRAN authors in addressing the inconsistencies, primarily A. Berk, Spectral Sciences, Inc., Burlington, Massachusetts, with G. Anderson, Air Force Research Laboratory, Hanscom AFB, Massachusetts, and E. Shettle, Naval Research Laboratory, Washington DC.